DOCUMENT RESUME

ED 281 510 IR 012 629

AUTHOR Podolski, Frederick M.
TITLE The Effect of CAI on the Performance of Elementary Students.
PUB DATE May 85
NOTE 57p.; Master's Thesis, State University of New York at Oswego.
PUB TYPE Dissertations/Theses - Master Theses (042)

EDRS PRICE MF01/PC03 Plus Postage.
DESCRIPTORS Comparative Analysis; *Computer Assisted Instruction; *Courseware; Dictionaries; Elementary Education; *Intermode Differences; *Language Arts; Literature Reviews; Material Development; Microcomputers; *Skill Development; Student Attitudes; Word Recognition
IDENTIFIERS Software Design

ABSTRACT

This investigation of the effect of computer-assisted instruction (CAI) on the performance of elementary students in the area of language arts skills compared the performance of students receiving CAI with that of students receiving only regular classroom instruction. Two software programs were created for use in the study. Word Breaker, designed for use at grade levels 2 and 3, encourages recognition and understanding of the composition of compound, prefixed, and suffixed words. Dictionary Hunt, written for use at grade 5, encourages the learner to understand unusual words and to expand vocabulary by consulting the dictionary. Students in the experimental groups (n=50 for Word Breaker and n=34 for Dictionary Hunt) were encouraged to go to the school media center and use the computer programs; students in the control groups (n=50 and n=38) received no special instruction. A comparison of the mean gains between the experimental groups using Word Breaker and their control groups indicates that the experimental groups had a greater gain in score for the total mean gain of all three subject areas covered by the program. A significant gain was shown by one experimental group for the task of categorizing in the Dictionary Hunt program, and comparison of this group's scores with those of a control group revealed a significant difference in favor of the students who had used the CAI program. Sample screens and the pre- and posttests used to measure student progress are appended. (MES)

**********
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
**********

ED281510

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

X This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

# The Effect of CAI on the Performance of Elementary Students

Frederick M. Podolski

A Thesis Submitted in
Partial Fulfillment of
The Degree of Master of
Science in Education

Department of Secondary Education
Professional Studies Division
College of Arts and Sciences
State University of New York
Oswego

May, 1985

Advisor: _____

Reader: _____

Dean of
Graduate Studies: _____

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

Frederick M. Podolski

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

IR012629

BEST COPY AVAILABLE

ABSTRACT

The purpose of this study was to investigate the effect of computer assisted instruction on the performance of elementary students in the area of language arts skills. In particular the study was an attempt to examine the performance of students receiving computer assisted instruction on compound words, prefixes, suffixes, and dictionary skills compared with the performance of those receiving only regular classroom instruction.

Two programs were created for use in the study. Word Breaker was designed for use at grade levels 2 and 3. This program was intended to encourage recognition and understanding of the composition of compound words, prefixed words and suffixed words. Dictionary Hunt was written for use at grade 5. When using the program, the learner was encouraged to understand unusual words and to expand vocabulary by consulting the dictionary.

Analysis of data from the Word Breaker program failed to demonstrate a significant gain in performance for the experimental groups between the pretest and posttest. Failure to achieve as expected was taken as an indication that some aspect of the study was faulty. The results of a teacher survey indicated that other factors could have affected the results of the study. Follow-up testing was initiated and the resulting analysis of the data yielded a significant total gain for all three subject areas by both the second and third grade experimental groups. The control groups had losses in most content areas.

A comparison of the mean gains between the experimental and control groups indicated that both second and third grade experimental groups had a greater gain in score than did the control for the total mean gain of all three subject areas. Even though they started out with lower initial performance, the experimental groups had a gain in score in the time period between the two tests while the control groups had a loss in performance. This increase in performance by the experimental groups was seen as an indication that CAI programs, such as the Word Breaker program, are effective learning aids when used in conjunction with regular classroom instruction in the language arts curriculum.

A significant gain was achieved by one experimental group for the task of categorizing in the Dictionary Hunt program. When the gain scores of this experimental group were compared with the control group at the same school, there was a significant difference in favor of the experimental group. Analysis of matching scores did not prove significant for either the experimental or control groups.

It was concluded that, had stricter experimental control been used, the results of the study might have shown an even greater gain in score for the experimental groups. It was recommended that the study be repeated with a wider range in sample, random assignments to groups, and an extended time frame that should begin at the second semester and avoid the end-of-the-year turmoil.

Table of Contents

Page

List of Tables.....vi

Chapter

I. Introduction
Background.....1
Rationale.....2
Purpose.....3
Definitions.....4
Research Hypothesis.....5

II. Review of Literature
CAI.....6
Attitude.....7
Software.....7
Authoring of CAI Programs.....8

III. Methods and Procedures
Software Development.....12
Word Breaker.....12
Dictionary Hunt.....12
Program features.....13
Subjects.....14
Instruments.....14
Procedures.....15
Analysis of Data.....17
Null Hypothesis.....17
Limitations.....17

IV. Results
Overview of the Study.....19
Analysis of Results.....19
Word Breaker.....19
Grade 2 match effectiveness.....20
Grade 3 match effectiveness.....21
Grade 2 pre-post comparison.....23
Grade 3 pre-post comparison.....24
Grade 2 pre-post results.....25
Grade 3 pre-post results.....26
Study investigation.....26
Teacher survey.....27
Grade 2 Form A pre-post comparison.....28
Grade 2 Form A pre-post results.....29
Grade 3 Form A pre-post comparison.....30
Grade 3 Form A pre-post results.....31
Dictionary Hunt.....32
Pre-post comparison for Dictionary Hunt.....33
Experimental-control comparison
for Dictionary Hunt.....34

V. Conclusions
Word Breaker.....35
Dictionary Hunt.....38
Recommendations.....40

Appendices
A: Word Breaker Sample Screens.....41
B: Dictionary Hunt Sample Screens.....42
C: Word Breaker Form A.....43
D: Word Breaker Form B.....45
E: Dictionary Hunt Form A.....47
F: Dictionary Hunt Form B.....48

References.....49

LIST OF TABLES


Table — Page

1. Mean Errors - Form A for Word Breaker School B - Grade 2.....20

2. Difference of Mean Errors and t Values: Form A Experimental Minus Control Match Effectiveness for Word Breaker Grade 2.....21

3. Mean Errors - Form A For Word Breaker - Grade 3.....22

4. Difference of Mean Errors and t Values: Form A Experimental Minus Control Match Effectiveness for Word Breaker - Grade 3.....23

5. Mean Gains, Standard Deviations and t Values: Form A Minus Form B for Word Breaker - Grade 2.....24

6. Mean Gains, Standard Deviations and t Values: Form A Minus Form B for Word Breaker - Grade 3.....25

7. Difference of Mean Gains and t Values: Pre-Post Gains Experimental Minus Control For Word Breaker - School B - Grade 2.....25

8. Difference of Mean Gains and t Values: Pre-Post Gains Experimental Minus Control For Word Breaker - Grade 3.....26

9. Mean Gains, Standard Deviations and t Values: Form A Pretest Errors Minus Posttest Errors For Word Breaker - Grade 2.....29

10. Difference of Mean Gains and t Values: Form A Pre-Post Gains Experimental Minus Control For Word Breaker - School B - Grade 2.....30

11. Mean Gains, Standard Deviations and t Values: Form A Pretest Errors Minus Posttest Errors For Word Breaker - Grade 3.....31

12. Difference of Mean Gains and t Values: Form A Pre-Post Gains Experimental Minus Control For Word Breaker - Grade 3.....32

13. Mean Gains, Standard Deviations and t Values: Form A Minus Form B for Dictionary Hunt - Grade 5....33

14. Difference of Mean Gains and t Values: Pre-Post Experimental Minus Control For Dictionary Hunt - Grade 5.....34

# CHAPTER I

# THE PROBLEM

## Background

The use of computers in everyday life has become a growing phenomenon as a result of various applications of the continual technological advances in the electronics and computer fields. Ramer (1981), in a statement before the New York State Education Committee for Instructional Technology, stated that computers are beginning to make an impact in the home and in schools and will become an ever present part of life in the near future. As new computer technology continues to have an impact on our society, it becomes increasingly important that schools initiate a plan to educate students in the use of computers and to incorporate them into the curriculum.

Downing (1982), in discussing the views of proponents and skeptics of what some call "the microcomputer revolution in education," stated that "a true revolution rests on forces that influence our daily lives--the way we spend our time at home and perform our duties at work" (p. 19). Downing further stated that the microcomputer was already having an influence in the work place and that there have been many events foreshadowing a major influence in the home. Many schools are now beginning to integrate microcomputers into their curricula. Levin (1982), in discussing a school district in Illinois, stated that one superintendent of schools purchased 220 microcomputers at a

cost of $250,000 because he felt that it was a top priority to ensure that all his 3,800 students would become familiar with microcomputers by the time they graduated.

Rationale

One issue that poses a limitation on the use of computer assisted instruction in the schools is the lack of good quality microcomputer software. Gattis (1982), in discussing educational computer software, stated that a:

> well-crafted program that makes full and efficient use of the capabilities of the computer it runs on, and that also embodies an effective instructional approach is a rare find. (p. 19)

Sheingold (1981), in a study investigating the impact of computer technology on education, noted that there existed both an inadequate quality and quantity of educational software, especially in areas other than mathematics. Sheingold further indicated the need for a "theory of software" showing the ways that ideas can be implemented in computer programs. In addition, Sheingold also indicated that research is needed on how different forms of computer assisted instruction (CAI) can meet different educational goals.

In a study of microcomputers in English education, Kahl (1982) concluded that, as schools increase the use of computers, there will be a demand for both "improved content and greater sophistication" in computer programs. Kahl also concluded, from a review of popular literature on computer assisted instruction, that "commercial software development

continues to be inadequate to meet educational goals" (p. 45).

In summarizing their findings, the Practical Applications of Research panel members (Staff, 1982) suggested that educators need to do more "action-oriented research" to find the most effective approaches to presenting computer-based learning materials. They encouraged researchers to find effective approaches to presenting CAI materials and then to investigate the circumstances under which these approaches could be made more effective.

With the anticipated increase in the educational use of microcomputers in all curricular areas, it seems to be of educational importance to do research for the purposes of developing more effective computer assisted instructional materials. This is especially true in areas such as language arts where few computer programs have been developed and little research has been done on the effectiveness of computer assisted instruction.

Purpose

This study was not an attempt to look at the advantages or disadvantages of CAI in general. It was, however, an attempt to investigate the effectiveness of CAI under certain conditions within a specific framework. The purpose of this study was to investigate the effect of computer assisted instruction on the performance of elementary students in the area of language arts skills. In particular

the study was an attempt to examine the performance of students using the computer as a learning aid in an elementary language arts curriculum compared with those receiving only regular classroom intruction.

Definitions

Computer assisted instruction (CAI). Educational instruction carried out by means of a computer. This instruction can range from the reproduction of material written earlier to the assembly of lessons from several components and the individualization by the computer program of lesson material to fit the characteristics of each student (Dyer, 1972).

Drill and practice. A form of computer assisted instruction in which students are given problems and their answers are corrected by the computer (Dyer, 1972).

Hardware. Kimberly (1981) defined hardware as "the individual components, i.e. mechanical, electromechanical, magnetic and electronic devices that comprise any computer system" (p. 179).

Microcomputer. A microcomputer is a small, self-contained computer that contains a microprocessor as the basic operating unit (Doerr, 1979).

Peripheral. A device in a computer system that is not part of the central computer but is used for input or output purposes, such as a music synthesizer or printer (Kimberly, 1981).

Printer. An output device that prints characters on

paper.

Software. According to Kimberly (1981), software is a program that can be changed and loaded as needed. Software is the language the programmer uses to communicate with the computer.

Tutorial. A type of computer assisted instruction where information is presented to the student on the computer screen. The student is periodically asked to respond to items so the program can assess how much the student has learned from each part of the lesson. The program then modifies the level of presentation based on the student's response (Dyer, 1972).

## Research Hypothesis

Elementary school students receiving computer assisted instruction on compound words, prefixes, suffixes, and dictionary skills display better performance in these subject areas than elementary school students who receive regular instruction only.

# CHAPTER II

## REVIEW OF RELATED LITERATURE

### CAI

Computers have now become an accepted learning tool in education. The use of microcomputers has grown in the last few years and continues to increase at a rapid rate. Golden (1982) predicted that there would be 300,000 to 650,000 computers in the schools by 1985. In fact, at the end of the 1983-84 school year, there were 730,000 personal computers in kindergarten through twelfth grade according to the annual study by TALMIS ("U.S. Approaching," 1984). This study projects that there will be approximately 1.2 million computers in use at the end of the 1984-85 school year.

Computers will change how educators teach children. Bernstein (1983) stated, "Computers have altered technique and method radically, by taking care of the necessary but tedious drill routines--leaving human teachers free to interact with students at a higher level" (p.23). He indicated that software will provide answers and procedural methods while teachers will present logic, teaching students how to use knowledge to find answers to problems. Frenzel (1984b) suggested that personal computers will help individualize instruction so all students can advance at their own pace. B.F. Skinner, quoted by Zientara (1985), stated, "The ordinary classroom holds the bright kids back and makes the kids that need more time go too fast. They fall further and further behind until they can't keep

up--it's a terrible system" (p. 34). Computers in the classroom can allow slow learners to catch up while giving more advanced learners the opportunity to explore more advanced subjects.

Attitude

Clement (1981) contended that one critical issue regarding the successful use of computer assisted instruction is the personal attitudes of students, teachers and administrators. How students and educators view and deal with the use of the microcomputer as a learning tool will be of great importance in the coming years. Clement (1981) stated that, while educators may have some fears and anxiety about computer assisted instruction, children have an overall positive attitude at all grade levels. In the author's judgment, some of the reasons for this positive attitude are: 1) lessons are self-paced; 2) there is a lack of embarrassment when mistakes are made; 3) students receive immediate feedback to their responses; 4) students have a general feeling that they learn better through the computer system; and 5) the computer bases its evaluations strictly on a student's performance, not on personal characteristics or the student's relationship with the teacher.

Software

The quantity of educational software has been expanding rapidly, but there has been much criticism from educators regarding the quality of the software. Coburn, Kelman, Roberts, Snyder, Watt and Weiner (1982) cited observers in

the educational computing scene as generally agreeing that most available educational software is disappointing, whether it is commercially produced or developed by teachers. Coburn et al. stressed that it is important for advocates of educational computing to develop strategies to protect teachers and students from poor software and to advance the development of good software.

According to Topp (1985) there are many sources of educational software that educators are using besides commercial packages. He stated that many boards of education are producing their own programs by hiring programmers to work with teachers. Teachers taking inservice courses have in some cases developed program ideas and organized the sequences to give to programmers. Topp further indicated that secondary students are sometimes utilized to program these ideas, but in other cases teachers are developing and programming their own software.

Development Considerations of CAI Programs

A major consideration in developing computer assisted instructional software is the programming language to use. Frenzel (1984a) indicated that the best choice is BASIC. He stated that BASIC comes with most microcomputers and is easy to use, and that there are hundreds of books as well as many seminars and courses available on BASIC programming. Programming in BASIC allows a programmer to easily modify, update or customize a CAI program for its intended users. Furthermore, programs created in BASIC can allow a teacher,

with training in microcomputer programming, to change or omit data in a CAI program to make it appropriate for use with students.

The basis of good educational software is the same as that of a good curriculum plan or an individual classroom lesson plan. It takes careful planning and development time by someone with a background in educational methods. Skinner, quoted by Zientara (1985), stated:

> Right now, the people who are designing for computers don't know much about behavior--they're computer people. They can think up smart ways to get kids interested, but they don't know how to teach. It's very easy to have a computer do all sorts of tricky things, to hook up things that you think will fascinate students and keep them interested. Pac-Man will keep them interested, too, but it doesn't teach them anything important. (p. 35)

Steinberg (1984) stated that creating good educational software involves understanding how CAI is different from traditional methods of instruction and how this difference affects the nature of the instructional presentation. Steinberg suggested that instructional and managerial decisions must be made by the software author that are not an issue in other school media such as text books. The author must decide not only how many questions to ask but whether to require the student to achieve a given level of mastery before proceeding with the lesson. Furthermore, Steinberg stated that the software author must be a subject matter expert, a tutor, a psychologist, a lesson designer, an evaluator, and a display artist, blending a knowledge of

computers with a knowledge of teaching and instructional design while being aware of the unique aspects of human interaction. The author must decide whether the student, the computer, the classroom teacher, or some combination of these will control the learning in a program.

The development of good educational software requires certain guidelines to assist the author in planning just as certain guidelines are used by eduators in curriculum development. The research organization, Computer Assisted Instruction for Migrants (CAIM), at the State University College of New York at Oswego has written a detailed set of minimum requirements for the development of educational microcomputer software. Each program written for CAIM must meet the following basic requirements (Kahl & Podolski, 1983):

1. educational objectives for each program or program segment must be clearly stated and pertinent to the curriculum and grade level of the intended user;
2. instructional content must correlate with the stated objectives;
3. reading level of directions and content must be commensurate with the ability of the intended user;
4. directions must be clear and concise;
5. method of presentation of content should motivate the user as well as be appropriate for the targeted grade level and content;
6. the time span for each lesson should not strain the attention span of the intended user - a minimum of 10 to 15 minutes per segment is recommended, depending upon user's ability.

7. each program should make the machine "user friendly"; that is, it personalizes by use of user's name and in a non-threatening manner;

8. each program should allow for self-pacing by the user;

9. each lesson should provide a large data bank of randomly-accessed questions to avoid repetitive sequences of items;

10. the user should be allowed the option of reading or sidestepping directions, depending upon his/her need;

11. the program should provide immediate feedback as to correctness of response from the user as well as access to explanations and examples as needed;

12. multiple exit points from the program should be provided for the user to avoid frustration;

13. where appropriate, explanations, examples, and text should be enhanced by the use of graphics, animation, sound, and/or color and rewards built into the program to motivate the user;

14. a summary of the lesson for review by the user should be provided before termination of any program segment. (pp. 4-5)

# CHAPTER III

## METHODS AND PROCEDURES

### Software Development

Software production was a major consideration in this study. Various elementary reading and language arts books were consulted in the selection of vocabulary and in the development of the concepts used in the programs. Programming books written for use with the Radio Shack Model I and III microcomputers were also consulted. The two computer programs were written by this author in 1983 using Microsoft BASIC. Sample screens of each program appear as Appendices A and B.

Word Breaker. This program was designed for use at grade levels 2 and 3. The program was intended to encourage recognition and understanding of the composition of compound words, prefixed words and suffixed words. Three hundred and sixty words were included in this program. The task of the learner is to separate the word by moving an arrow on the screen, using the keyboard arrow keys, to the point of division (on the second word of a compound word, on the root word of a prefixed word, and on the suffix of a suffixed word) and pressing the Enter key.

Dictionary Hunt. This program was written for use at grade five. While using the program, the learner is encouraged to understand unusual words and to expand vocabulary by consulting the dictionary. The sixty selected

words were nouns from different cultures drawn from the categories of food, clothing, and dwelling styles. The learner is asked to categorize the word presented as representing something to eat, wear, or live in.

Program features. The programs were constructed in accordance with the guidelines for authoring. They included personalization by use of the learner's first name and the option of having directions presented at the beginning of the lesson. In addition, the programs provided self-pacing, choice of graded levels, immediate feedback as to correctness of response, and rewards for various achievement levels spaced throughout the lesson. Both programs were constructed to allow two attempts at the correct answer, and they provided the learner with a summary of achievement, including the option to produce the summary in printed form. The programs also utilized randomly chosen graphics and musical rewards to heighten interest and maintain the learner's attention. Word Breaker included the option for the teachers to input their own words in the program, a feature that was not implemented in the current study.

The programs were developed on a Radio Shack Model III microcomputer, and can be used with the Radio Shack Model III, 4, or 4P. Computer requirements are a minimum of 48K of random access memory and one disk drive. When Word Breaker is operated on a Model 4 or 4P microcomputer, the program automatically uses the built-in speaker to generate music. If operated on a Model III, the program prompts the

user to attach an optional audio amplifier to generate the musical rewards.

Subjects

The total sample (N=172) in the study consisted of students at grade levels 2, 3 and 5, from two elementary schools in a small city school district in upstate New York. The sample of students (n=50) who used the Word Breaker program and the students (n=50) who served as a control group consisted of children in grades 2 and 3. The sample of students (n=34) who used the Dictionary Hunt program and the students (n=38) who served as a control group consisted of fifth graders.

Instruments

From the word lists of each program, a pretest and a posttest were developed for use with each experimental treatment. Initial development of the tests included writing a program in BASIC to draw words randomly from each level in the programs. Two separate forms, each having a unique list of words, were completed for each program. The tests for use with Word Breaker each contained three content areas with twenty-four words in each area. The three content areas included were compound words, prefixes, and suffixes. The tests used with Dictionary Hunt were constructed with two response columns. Column I involved item matching. Column II required categorizing. Copies of all four forms appear as Appendices C through F. These tests were then piloted with students in two schools not

involved with the experimental study. The Word Breaker tests were administered to two classes at grades 2 and 3. Each was randomly split into two groups, each receiving one variation of the test. The Dictionary Hunt tests were used at the fifth grade level in the same format.

The mean of each word item was computed for each instrument. Two new tests were then created from these words, each having similar average difficulty in each content area. The resulting instruments were the pretests and posttests used in the study.

Procedures

As the programs were developed, they were tested for errors and for clarity of presentation. Revisions in data and program routines were made as necessary. Final development of the programs was completed in November, 1983.

The assistant superintendent and the principals of the two chosen schools were contacted for permission to conduct the study. A district guidance counselor assisted in securing the participation of teachers. For the purposes of this study the schools will be referred to as School A and School B.

The pretests for both programs were given to the experimental and control groups in May, 1984. The microcomputer programs were then made available for student use. The students in School A were sent to the library/media center to use the programs. In School B

computers were located in the classroom for the students' use.

Teachers in the experimental group were asked to encourage the children to use the programs but not to include any instruction in the content area of the computer programs other than what was already planned for that time of year. Teachers in the control group were also instructed not to include any instruction in the content area of the computer program other than what was already planned for that time of year. The posttests were given during the last week of school in June.

Analysis of the data from the Word Breaker program failed to demonstrate a significant gain in performance for the experimental groups between the pretest and posttest. Consequently, each of the teachers of the experimental and control groups at one of the schools was interviewed in an attempt to determine whether unrecognized factors affected the results. The ensuing answers indicated that both other testing and the time of year existed as limitations that had not been anticipated. As a result of the initial data analysis and the teacher survey, it was determined that further data collection was needed. Given the lack of pre-post gains by the experimental group, the posttest instrument and/or conditions of administration were deemed to have flawed the data collection. It was decided to administer the pretest (Form A) as a delayed posttest to the School B subjects in October, 1984. The assistant

superintendent of schools and the school principals were contacted for permission to repeat the data collection.

Analysis of Data

The Word Breaker subscores from each of the three content areas (compound words, prefixes, and suffixes) were computed in terms of the number of errors. The mean and standard deviation for each of the sections and the total score for all sections were calculated. The mean gain scores were then subjected to a t test for two related means.

Following initial examination of the data from the pre-post gains, it was decided to administer the pretest instrument again following the summer recess. The results from Form A, used as both pretest and posttest, were subjected to a section-by-section analysis.

Means and standard deviations were computed for both the matching and categorizing parts of the Dictionary Hunt measuring device. The resulting pre- and posttest subscore means for the experimental and control groups were compared using the appropriate t test for dependent or independent means.

Null Hypothesis

There is no difference, at the .05 level of significance, in mean gains between students using CAI and those following only the regular curriculum.

Limitations

The first limitation was the length of the study.

Since it lasted only one month, one could not be sure if enough time had elasped between the pretest and the posttest for a gain to be effected. Another limitation in the study was the accessibility of microcomputers. The fact that one school had only two microcomputers located in the library/media center put a constraint upon the amount of time a student could spend using the programs. The fact that each teacher in the experimental group controlled student access to the programs allowed for the possibility of non uniform treatment. Teacher attitudes, toward both computers and the study, were also seen as a possible limitation.

# CHAPTER IV

# RESULTS

## Overview of the Study

The objective of this study was to investigate the effect of CAI on students' performance in the elementary language arts curriculum in the content areas of compound words, prefixed words, suffixed words and dictionary skills.

## Analysis of Results

Table 1 through Table 14 are presentations of the data analysis for the pretest and posttest results related to the use of Word Breaker and Dictionary Hunt. Student scores were computed as the number of errors. Each of the three subsections of the instruments used with Word Breaker contained 24 test items. The two subsections of the Dictionary Hunt instruments each contained 30 items. The means resulting from subtracting posttest mean errors from pretest mean errors reflect a gain in student performance between the pretest and the posttest. All reported standard deviations are unbiased.

Word Breaker. This program covered three content areas: compound words, prefixes and suffixes. Form A was intended as a pretest to all groups under study and Form B was intended as a posttest. In fact, the pretest was not administered to the second grade control group at School A. Although the pretest was completed by the second grade experimental group at School A, few students had the

opportunity to use the Word Breaker program and then only on a very limited basis. Due to these events, the data for second grade groups at School A was not analyzed and is not presented.

Grade 2 match effectiveness for Word Breaker. Table 1 is a summary of mean error scores on the pretest of the grade 2 groups at School B. In all three content areas, the control group had a lower number of mean errors than

TABLE 1

MEAN ERRORS - FORM A FOR WORD BREAKER
SCHOOL B - GRADE 2

| | EXPERIMENTAL | | | CONTROL | | |
|---|---|---|---|---|---|---|
| | MEAN | S.D. | N | MEAN | S.D. | N |
| Compound Words | 1.50 | 2.46 | 18 | .81 | 1.33 | 16 |
| Prefixes | 9.72 | 5.99 | 18 | 5.88 | 3.59 | 16 |
| Suffixes | 6.89 | 6.13 | 18 | 5.56 | 5.11 | 16 |
| Total | 18.11 | 13.31 | 18 | 12.25 | 9.00 | 16 |

the experimental group; thus the control had a higher initial performance level in all areas. The experimental group's mean total errors on the pretest was 18.11 while the mean total errors for the control group was 12.25.

Table 2 is a presentation of the difference of mean errors between the School B experimental and control groups in grade 2. The difference is the result of the experimental group's pretest mean errors minus the control group's pretest mean errors. A t test for two independent means was performed on the mean difference in pretest scores for each content area and on the total difference as a measure of the initial achievement equivalence between the

TABLE 2

DIFFERENCE OF MEAN ERRORS AND *t* VALUES
FORM A EXPERIMENTAL MINUS CONTROL
MATCH EFFECTIVENESS FOR WORD BREAKER GRADE 2 - SCHOOL B

| | DIFFERENCE OF MEAN ERRORS | *t* | N |
|---|---|---|---|
| Compound Words | .69 | 1.03 | 34 |
| Prefixes | 3.84 | 2.30* | 34 |
| Suffixes | 1.33 | .69 | 34 |
| Total | 5.86 | 1.60 | 34 |

* - Significant at the .05 level

two groups. Applying the formula to the data resulted in a significant *t* value of 2.30 for the content area of prefixed words (*cv* .05, 32 *df* = 2.04). The performance of the control group was higher in all categories than the experimental group and significantly higher on the prefix subscore.

Grade 3 match effectiveness. Table 3 is a display of the grade 3 mean errors on the pretest at Schools A and B. With the exception of suffixed words for School A, the control group had lower mean errors than the experimental group at both schools in all three content areas. Thus, the third grade control groups had a higher performance level at the initiation of the study. The mean total errors for the experimental group at School A was 8.50 as opposed to 6.88 for the School A control group. The mean of the total errors for the experimental group at School B was 11.42 compared with 6.94 for the School B control group. The mean of the total errors for the combined experimental groups at Schools A and B was 9.60 in contrast to 6.91 for the

combined control groups.

TABLE 3

MEAN ERRORS - FORM A
FOR WORD BREAKER - GRADE 3

| | EXPERIMENTAL | | | CONTROL | | |
|---|---|---|---|---|---|---|
| | MEAN | S.D. | N | MEAN | S.D. | N |
| Compound Words | | | | | | |
| School A | .65 | .75 | 20 | .50 | .71 | 18 |
| School B | .92 | 1.24 | 12 | .13 | .34 | 16 |
| Combined | .75 | .95 | 32 | .32 | .59 | 34 |
| Prefixes | | | | | | |
| School A | 5.75 | 3.46 | 20 | 3.94 | 2.36 | 18 |
| School B | 7.33 | 5.26 | 12 | 5.50 | 3.40 | 16 |
| Combined | 6.34 | 4.22 | 32 | 4.68 | 2.96 | 34 |
| Suffixes | | | | | | |
| School A | 2.10 | 3.00 | 20 | 2.44 | 3.71 | 18 |
| School B | 3.17 | 4.22 | 12 | 1.31 | 2.50 | 16 |
| Combined | 2.50 | 3.48 | 32 | 1.91 | 3.20 | 34 |
| Total | | | | | | |
| School A | 8.50 | 6.47 | 20 | 6.88 | 5.60 | 18 |
| School B | 11.42 | 8.83 | 12 | 6.94 | 5.20 | 16 |
| Combined | 9.60 | 7.44 | 32 | 6.91 | 5.33 | 34 |

The difference in mean error scores between the grade 3 experimental and control groups at Schools A and B is presented in Table 4. The difference is the result of each experimental group's Form A mean errors minus each control group's Form A mean errors. A *t* test for two independent means was performed on the mean difference in pretest scores for each content area and for the total difference.

A significant advantage in initial performance on compound words existed for the School B control group and for the combined groups (*cv* .05, 25 *df* = 2.06). While only statistically significant in the area of compound words, the grade 3 control groups had higher initial achievement means in eleven of the twelve possible comparisons.

TABLE 4

DIFFERENCE OF MEAN ERRORS AND t VALUES
FORM A EXPERIMENTAL MINUS CONTROL
MATCH EFFECTIVENESS FOR WORD BREAKER - GRADE 3

| | DIFFERENCE OF MEAN ERRORS | t | N |
|---|---|---|---|
| Compound Words | | | |
| School A | .15 | .63 | 38 |
| School B | .79 | 2.15* | 26 |
| Combined | .43 | 2.19* | 66 |
| Prefixes | | | |
| School A | 1.81 | 1.90 | 38 |
| School B | 1.83 | 1.05 | 26 |
| Combined | 1.66 | 1.84 | 66 |
| Suffixes | | | |
| School A | - .34 | - .31 | 38 |
| School B | 1.86 | 1.36 | 26 |
| Combined | .59 | .72 | 66 |
| Total | | | |
| School A | 1.62 | .83 | 38 |
| School B | 4.48 | 1.57 | 26 |
| Combined | 2.69 | 1.68 | 66 |

* - Significant at the .05 level

Grade 2 pre-post comparison. Table 5 is a summation of the results of a topic-by-topic analysis for grade 2. The means, standard deviations and t values listed are based on Form A mean errors minus Form B mean errors.

The t test for two related means was performed on the mean gain for each content area and on the mean total gain. The test was used to investigate whether or not a significant difference occurred in the mean gain scores. A significant gain occurred only on compound words with the School B control group (t = 2.65, cv .05, 15 df = 2.13).

TABLE 5

MEAN GAINS, STANDARD DEVIATIONS AND t VALUES
FORM A MINUS FORM B FOR WORD BREAKER - GRADE 2

| | MEAN GAIN | S.D. | t | N |
|---|---|---|---|---|
| Compound Words | | | | |
| School B - Experimental | .44 | 1.29 | 1.45 | 18 |
| School B - Control | .75 | 1.13 | 2.65* | 16 |
| Prefixes | | | | |
| School B - Experimental | 1.50 | 3.94 | 1.62 | 18 |
| School B - Control | - .25 | 4.16 | - .24 | 16 |
| Suffixes | | | | |
| School B - Experimental | .17 | 5.59 | .13 | 18 |
| School B - Control | - .44 | 4.02 | - .44 | 16 |
| Total Gain | | | | |
| School B - Experimental | 2.11 | 7.49 | 1.20 | 18 |
| School B - Control | .06 | 7.10 | .03 | 16 |

* - Significant at the .05 level

Grade 3 pre-post comparison. Table 6 is a presentation of the results of a topic-by-topic analysis of gain scores for grade 3 students. A test for two related means was performed on the mean gains resulting from pretest (Form A) mean errors minus posttest (Form B) mean errors for each content area and on the total. A significant gain occurred in the School B experimental group for compound words ($t$ = 2.42, cv .05, 11 df = 2.20). The School B control group had a significant gain, at the .01 level, for prefixed words and for the mean total gain. It is also noted that there was a significant loss in performance on suffixed words, at the .01 level, for the School A experimental group.

TABLE 6

MEAN GAINS, STANDARD DEVIATIONS AND t VALUES
FORM A MINUS FORM B FOR WORD BREAKER - GRADE 3

| | MEAN GAIN | S.D. | t | N |
|---|---|---|---|---|
| Compound Words | | | | |
| School A - Experimental | .30 | .80 | 1.68 | 20 |
| School A - Control | .17 | .71 | 1.02 | 18 |
| School B - Experimental | .83 | 1.19 | 2.42* | 12 |
| School B - Control | .13 | .34 | 1.56 | 16 |
| Prefixes | | | | |
| School A - Experimental | .65 | 2.35 | 1.24 | 20 |
| School A - Control | .33 | 2.70 | .52 | 18 |
| School B - Experimental | 1.42 | 5.04 | .98 | 12 |
| School B - Control | 2.44 | 2.48 | 3.94** | 16 |
| Suffixes | | | | |
| School A - Experimental | -1.95 | 2.67 | -3.27** | 20 |
| School A - Control | -1.44 | 4.98 | -1.23 | 18 |
| School B - Experimental | -1.25 | 3.11 | -1.39 | 12 |
| School B - Control | - .38 | 1.26 | -1.21 | 16 |
| Total Gain | | | | |
| School A - Experimental | -1.00 | 2.83 | -1.58 | 20 |
| School A - Control | - .94 | 7.10 | - .57 | 18 |
| School B - Experimental | 1.00 | 6.59 | .53 | 12 |
| School B - Control | 2.19 | 2.10 | 4.15** | 16 |

* - Significant at the .05 level
** - Significant at the .01 level

Grade 2 pre-post results. Table 7 is the compilation of the difference of mean gains between the grade 2 experimental and control groups at School B. The difference of mean gains and t values listed are based on the pre-post

TABLE 7

DIFFERENCE OF MEAN GAINS AND t VALUES
PRE-POST GAINS EXPERIMENTAL MINUS CONTROL
FOR WORD BREAKER - SCHOOL B - GRADE 2

| | DIFFERENCE OF GAINS | t | N |
|---|---|---|---|
| Compound Words | - .31 | -.75 | 34 |
| Prefixes | 1.75 | 1.26 | 34 |
| Suffixes | .61 | .37 | 34 |
| Total Difference | 2.05 | .82 | 34 |

gain scores of the experimental group minus those of the control group. Performing t tests for two independent means, on the difference of pre-post mean gains between the groups, produced no significant results.

Grade 3 pre-post results. Presented in Table 8 are the differences in mean gains between the grade 3 experimental and control groups in Schools A and B. The differences and t values listed are computed from the pre-post gain of each experimental group minus that of each control group. No significant differences between the

TABLE 8
DIFFERENCE OF MEAN GAINS AND t VALUES
PRE-POST GAINS EXPERIMENTAL MINUS CONTROL
FOR WORD BREAKER - GRADE 3

| | DIFFERENCE OF GAINS | t | N |
|---|---|---|---|
| Compound Words | | | |
| School A | .13 | .53 | 38 |
| School B | .70 | 1.98 | 28 |
| Prefixes | | | |
| School A | .32 | .39 | 38 |
| School B | -1.02 | - .64 | 28 |
| Suffixes | | | |
| School A | - .51 | - .39 | 38 |
| School B | - .87 | - .91 | 28 |
| Total Difference | | | |
| School A | - .06 | - .03 | 38 |
| School B | -1.19 | - .60 | 28 |

groups were found as a result of performing the t tests for two independent means.

Study investigation. After analysis of the data it was decided to investigate further the testing conditions. This was first of all due to the failure to find significant changes between the pretest and posttest results for the

majority of the experimental groups. Secondly, analysis of the data revealed that, at the inception of the study, the control groups had higher performance levels than the experimental groups.

Teacher survey. In the summer of 1984 a questionnaire was organized to present to the six teachers involved in the study. The librarian in charge of microcomputers at School A was also surveyed.

Of the teachers surveyed, 50% stated that over-testing during the study could have affected the results. In addition to regular classroom testing, three major tests were administered district-wide to the subjects involved in the study. Furthermore, half the teachers felt that conducting the study at the end of the school year could also have affected the results of the study. Three of those surveyed stated that the program used in the study was of good quality. The third grade control group teacher for School B stated that prefixed words had been included as part of the normal instructional pattern during the time of the study. This control group showed a significant gain score with prefixed words. The second grade control group teacher for School B stated that all three topic areas had been included as part of normal instruction during the time of the study. This control group showed a significant gain score for compound words.

In view of the results of this teacher survey and the unequal initial performance level between the experimental

and control groups, it was decided to conduct follow-up testing. The retesting was conducted at School B since it contained the largest sample. It is also noted that at the end of the study, one School A teacher had reported that it was very difficult for students to gain access to the two microcomputers in the library/media center because the computers were in general use. This lack of access was viewed as a possible limitation of the study.

Inasmuch as the Form B posttesting resulted in little or, in some cases, negative gain for most of the groups, the Form B instrument was also viewed as a possible source of error in the study. Due to this factor, the Form A instrument was used for the follow-up testing to eliminate the possibility of unequal difficulty in the two forms of the device. The Form A instrument was readministered as a delayed posttest to School B second and third grade experimental and control students in October, 1984.

Grade 2 Form A pre-post comparison. Table 9 is a presentation of the means, standard deviations and *t* values based on the Form A pretest mean errors minus the Form A posttest mean errors. A *t* test for two related means was performed on the resulting pre-post gains for each group. Significant gain occurred in the experimental group for compound words (*cv* .05, 17 *df*, one tail = 1.74), prefixed words (*cv* .01, 17 *df*, one tail = 2.57) and for the mean gain of all three content areas combined (*cv* .01, 17 *df*, one tail = 2.57). In view of these results, the null hypothesis that

TABLE 9

MEAN GAINS, STANDARD DEVIATIONS AND t VALUES
FORM A PRETEST ERRORS MINUS POSTTEST ERRORS
FOR WORD BREAKER - GRADE 2

| | MEAN GAIN | S.D. | t | N |
|---|---|---|---|---|
| Compound Words | | | | |
| School B - Experimental | .50 | 1.20 | 1.77* | 18 |
| School B - Control | - .25 | 1.07 | - .93 | 16 |
| Prefixes | | | | |
| School B - Experimental | 3.22 | 3.57 | 3.83** | 18 |
| School B - Control | -2.19 | 4.23 | -2.07* | 16 |
| Suffixes | | | | |
| School B - Experimental | 1.06 | 4.18 | 1.08 | 18 |
| School B - Control | .56 | 4.34 | .52 | 16 |
| Total Gain | | | | |
| School B - Experimental | 4.78 | 6.66 | 3.05** | 18 |
| School B - Control | -1.88 | 5.80 | -1.30 | 16 |

* - Significant at the .05 level
** - Significant at the .01 level

there is no gain in performance was rejected with regard to the subsample of grade 2 experimental subjects. Futhermore, the control group had losses in two of the three subtests and in the total, with a significant loss in the mean score for prefixed words.

Grade 2 Form A pre-post results. Table 10 is a presentation of the differences in mean gains between the grade 2 experimental and control groups at School B. These differences and associated t values are based on the Form A pre-post gain scores of the experimental group minus those of the control group. In all content areas the experimental group showed a greater average gain. This is a substantial increase in the gain scores for the experimental group compared to the pre-post gain scores that were presented in Table 7.

TABLE 10

DIFFERENCE OF MEAN GAINS AND t VALUES
FORM A PRE-POST GAINS EXPERIMENTAL MINUS CONTROL
FOR WORD BREAKER - SCHOOL B - GRADE 2

| | DIFFERENCE OF GAINS | t | N |
|---|---|---|---|
| Compound Words | .75 | 1.92* | 34 |
| Prefixes | 5.41 | 4.00** | 34 |
| Suffixes | .50 | .34 | 34 |
| Total Difference | 6.71 | 3.08** | 34 |

* - Significant at the .05 level
** - Significant at the .01 level

A t test for two independent means was performed on the difference of Form A pre-post mean gains of the experimental group minus those of the control group for each content area and for the total difference. The experimental group had a greater mean gain in the area of compound words at the .05 level. A significant difference in scores also existed in favor of the experimental group at the .01 level in the area of prefixed words and in the mean total gain.

Grade 3 Form A pre-post comparison. Presented as Table 11 are the results of a topic-by-topic analysis for grade 3 in School B. The means, standard deviations and t values listed are based on the Form A pretest mean errors minus the Form A posttest mean errors.

A t test for two related means was performed on the resulting gain for each content area and for the mean total gain. A significant gain occurred in the experimental group for suffixed words (cv .01, 11 df, one tail = 2.72) and the mean gain of combined scores for (cv .05, 11 df, one tail = 1.80). In regard to the School B third grade experimental

TABLE 11

MEAN GAINS, STANDARD DEVIATIONS AND t VALUES FORM A PRETEST ERRORS MINUS POSTTEST ERRORS FOR WORD BREAKER - GRADE 3

| | MEAN GAIN | S.D. | t | N |
|---|---|---|---|---|
| Compound Words | | | | |
| School B - Experimental | .58 | 1.44 | 1.40 | 12 |
| School B - Control | 0.00 | .52 | 0.00 | 16 |
| Prefixes | | | | |
| School B - Experimental | 2.33 | 5.99 | 1.35 | 12 |
| School B - Control | 1.44 | 1.93 | 2.98** | 16 |
| Suffixes | | | | |
| School B - Experimental | .67 | .65 | 3.57** | 12 |
| School B - Control | - .50 | 1.03 | - 1.94* | 16 |
| Total Gain | | | | |
| School B - Experimental | 3.58 | 6.01 | 2.06* | 12 |
| School B - Control | .94 | 1.91 | 1.97* | 16 |

* - Significant at the .05 level
** - Significant at the .01 level

group on suffixed words, the null hypothesis that there is no change in performance can be rejected, not only at the .05 level, but also at the .01 level. When applied to the third grade experimental group at School B for the total score, the null hypothesis that there is no change in performance was rejected at the .05 level. The control group showed a significant mean gain for prefixed words but, as noted from the teacher survey, this group had classroom instruction with prefixed words during the time of the study.

Grade 3 Form A pre-post results. Table 12 is a presentation of the differences in mean gains between the School B grade 3 groups. The experimental group had a greater gain in all comparisons. This is an increase in performance for the School B experimental group, with the

exception of the area of compound words, which stayed relatively the same in comparison to the pre-post gain scores presented in Table 8.

TABLE 12
DIFFERENCE OF MEAN GAINS AND t VALUES
FORM A PRE-POST GAINS EXPERIMENTAL MINUS CONTROL
FOR WORD BREAKER - GRADE 3

| | DIFFERENCE OF GAINS | t | N |
|---|---|---|---|
| Compound Words | .58 | 1.34 | 28 |
| Prefixes | .89 | .50 | 28 |
| Suffixes | 1.08 | 3.36** | 28 |
| Total Difference | 2.64 | 1.47 | 28 |

** - Significant at the .01 level

A t test for two independent means was performed on the difference of Form A pre-post mean gains between the experimental and control groups for each content area and for the total difference. The performance on suffixed words of the School B experimental group was significantly higher than that of the control group (t = 3.36, cv .01, 26 df = 2.78).

Dictionary Hunt. This program covered a wide variety of words representing the food, clothing, and dwelling styles of diverse cultures. As each word was presented, the student was asked if the word represented something that would be eaten, worn, or lived in. The primary objective of the program was to encourage students to use a dictionary. The end result of this objective was to improve the student's ability to differentiate among uncommon terms. The Form A and Form B instruments devised to measure student performance contained two columns. Column I was a matching

test designed to investigate if students would develop an increased recognition of definitions as the result of using the program. Column II was designed to investigate if improvement of performance in categorizing would occur as the result of using the Dictionary Hunt program. The score on this part of the test was subject to the student's skill at correctly placing words into the three categories involved in the program.

Pre-post comparison for Dictionary Hunt. Table 13 is a presentation of the results of an analysis of Column I and Column II scores. The mean gains, standard deviations and t values listed are based on the results of Form A mean errors minus Form B mean errors.

A t test for two related means was performed on the pre-post difference in scores for each group. Analysis of categorizing scores indicated a significant gain in performance for the School B experimental group (t = 2.51,

TABLE 13

MEAN GAINS, STANDARD DEVIATIONS AND t VALUES
FORM A MINUS FORM B FOR DICTIONARY HUNT - GRADE 5

| | MEAN GAIN | S.D. | t | N |
|---|---|---|---|---|
| Column I | | | | |
| School A - Experimental | -1.29 | 3.93 | -1.23 | 14 |
| School A - Control | - .37 | 4.96 | - .33 | 19 |
| School B - Experimental | .10 | 4.10 | .11 | 20 |
| School B - Control | - .26 | 4.56 | - .25 | 19 |
| Column II | | | | |
| School A - Experimental | 1.29 | 5.58 | .87 | 14 |
| School A - Control | .42 | 4.57 | .40 | 19 |
| School B - Experimental | 1.85 | 3.30 | 2.51* | 20 |
| School B - Control | -2.26 | 3.90 | -2.53* | 19 |

* - Significant at the .05 level

cv .05, 19 df = 2.09) and a significant loss in performance for the School B control group (t = -2.53, cv .05, 18 df = -2.10). When applied to the School B experimental group in categorizing words, the null hypothesis that there is no change in performance can be rejected at the .05 level.

Experimental-control comparison for Dictionary Hunt. Table 14 is a presentation of the difference in mean gains between the experimental and control groups at Schools A and B. The difference of gains for each comparison was computed as the Form A mean gain minus Form B mean gain.

A t test for two independent means was performed on the mean difference in pre-post gain scores for each group.

TABLE 14

DIFFERENCE OF MEAN GAINS AND t VALUES
PRE-POST EXPERIMENTAL MINUS CONTROL
FOR DICTIONARY HUNT - GRADE 5

| | DIFFERENCE OF GAINS | t | N |
|---|---|---|---|
| Column I | | | |
| School A | - .92 | - .59 | 33 |
| School B | .36 | .26 | 39 |
| Column II | | | |
| School A | .87 | .48 | 33 |
| School B | 4.11 | 3.54** | 39 |

** - Significant at the .01 level

When compared to the control group, the School B experimental group had a significantly greater mean gain in the ability to categorize the information. The difference in the mean gains between the two groups was 4.11 resulting in a significant t value of 3.54 (cv .01, 37 df = 2.75).

# CHAPTER V

# CONCLUSIONS

## Word Breaker

Analysis of the initial data collected in the study resulted in only one significant increase in student performance for the experimental groups involved. In addition, there was a significant loss in performance at the .01 level by a third grade experimental group in the subject area of suffixes. Furthermore, there was a significant gain, at the .01 level, by a third grade control group in the subject area of prefixes and for the total gain.

Higher gains were expected for the experimental groups than those that resulted. Further analysis of the original pretest data revealed that in all cases, the experimental groups committed a greater number of errors than the control groups. This would tend to show that the control groups started out with a higher skill level.

Failure to achieve as expected was taken as an indication that some aspect of the study could be faulty. It was decided to investigate further the manner in which the study was conducted in the schools. A follow-up survey was designed and administered to the teachers involved. The ensuing answers indicated that other factors could have affected the results of the study. It was noted by teachers surveyed that the end of the school year was a particularly bad time for the study. Teachers also mentioned that students were generally less attentive during the last month

of school. The fact that three major district-wide tests were given during the study could have affected the students' attitude toward the posttest instrument. One teacher emphasized the potential effect on student attitude, stating that, "they were over-tested." In School A, the fact that students had to go to the library/media center created scheduling difficulties and limited the length of time each student could spend with the program. Only two computers were located in the library/media center for use by kindergarten through sixth grade students. The possibility of an unequal balance between the Form A and Form B devices existed as another source of error in the study. Furthermore, it can be noted that the teacher in each experimental classroom was the sole administrator of the treatment. The teacher's attitude toward computers and toward the study could have affected the amount of treatment each subject received and, in addition, could have affected each student's attitude toward using the programs.

As a result of follow-up testing with the Form A instrument, analysis of the data yielded a significant total gain for all three subject areas by the experimental groups at both the second and third grade levels. The total gain for the second grade experimental group was significant at the .01 level. The total gain for the third grade group was significant at the .05 level. At the second grade level the control group had losses in two of the three subtests and in the total, with a significant loss in the mean score for

prefixed words. The third grade control group showed a significant loss in the area of suffixes.

A comparison between the mean gains of the experimental and control groups indicated that both second and third grade School B experimental groups had a greater gain in score than did the control groups for the total mean gain of all three subject areas. This was an increase in the gain scores for the experimental groups at both grade levels compared with the experimental minus control differences in pre-post gain scores using the Form B posttest. It can be noted that for both grade levels there was a loss by all the control groups in the three months between the administering of the Form B posttest and the follow-up testing repeating the Form A device. Even though they started out with a lower degree of performance, the experimental groups had a gain in score in the time period between the two tests while the control groups had a loss in performance.

This increase in performance by the experimental group would tend to show that CAI programs, such as the Word Breaker program, are effective learning aids when used with regular classroom instruction. Furthermore, such programs might tend to assist students in retaining information over a period of time.

These results were obtained when the subjects used the program for only one month. Had the length of the study been longer, the experimental groups might have achieved greater gain scores.

When asked for their opinion of the Word Breaker program in the follow-up teacher survey, 75% stated that the program was of good quality. The librarian at School B indicated that the students seemed to understand and enjoy the program. The second grade experimental teacher at School B stated that, after previewing quite a few commercial programs available in the district, the Word Breaker program was comparatively very good. The third grade experimental teacher at School B indicated that she wished the Word Breaker program were available for ongoing use as reinforcement in teaching compound words, prefixes and suffixes.

Dictionary Hunt

The primary objective of the Dictionary Hunt program was to familiarize students with using the dictionary. In an effort to encourage their use of the dictionary to answer the questions in the program, they were given unusual words that might not be encountered in everyday vocabulary. Students were not asked to give a definition of the words presented in the program. The desired result of using Dictionary Hunt, besides the use of the dictionary with the program, was an improvement in the students' ability to differentiate among uncommon terms. The matching section of the instruments was designed to investigate whether using Dictionary Hunt would increase the students' vocabulary.

A significant gain occurred with the experimental group for School B for the task of categorizing. The increase in

student performance on column II, between pretest and posttest scores for this group was significant at the .05 level. The School A experimental group's gain in score for categorizing was not significant.

At the end of the study, the School A experimental teacher stated that it took a very long time for students to go through all levels in the program. This teacher mentioned that, due to the tight scheduling of computer time in the library/media center of this school, students were not able to spend the time needed with the program. The teacher further stated that only a few students had the opportunity to complete all sixty words. The information obtained from the teacher survey for the Word Breaker program could explain the low gain score of the School A experimental group using the Dictionary Hunt program.

The School A control group also showed a small gain in score while the School B control group showed a significant loss in score for the task of categorizing. At School B, when the gain scores of the experimental and control groups were compared, there was a significant difference in favor of the experimental group at the .01 level. This result, as well as the fact that the experimental students at School A had difficulty accessing the program, would tend to indicate that, had the School A experimental students also had a computer located in their classroom, their gain scores might have been greater. Analysis of matching scores did not prove significant for either the experimental or control

groups.

The School A experimental teacher suggested that the time segment between questions be speeded up to shorten the length of time a student needs to complete all lessons. In the present program many time delays and graphics rewards are used between questions to hold the attention of the average learner. The School A experimental teacher also suggested that the words in the program be examined for leveling of difficulty. These suggestions will be considered if a future revision of the program is made.

Recommendations

Had stricter experimental control been used, the results of the study might have shown a greater gain in score for the experimental groups. What happens with computers in the public schools is not under strict experimental control. The results of the study may be more reflective of this manner in which computers and software are actually used.

The study should be repeated with a wider range in the sample, random assignments to groups within the sample, and an extended time frame. Based upon recommendations from the teachers' survey, a future study should begin at the second semester and avoid the end-of-the-year turmoil. A teacher review of the Dictionary Hunt program is also suggested by the results of this study. For future studies, copies of the copyrighted programs may be obtained from the author.

# APPENDIX A
# WORD BREAKER SAMPLE SCREENS

Would you like instructions,
Fred (Y = YES N = NO)? Y__

Welcome to WORD BREAKER,
Fred!

Choose the LETTER of the
word group you want and
press the white (ENTER) key.

(C) - Compound Words
(P) - Prefixes
(S) - Suffixes
(E) - END Program

Which group do you want? C

Choose grade 2, 3, or 4 and
press (ENTER). 3

Choose level 1, 2, 3, or 4 and
press (ENTER). 4

QUESTION-9 RIGHT-8

Move the arrow to the FIRST
letter of the SECOND word
and press the (ENTER) key.

The second word is NOT
"craper".

*** skyscraper ***

QUESTION-9 RIGHT-9

Move the arrow to the FIRST
letter of the SECOND word
and press the (ENTER) key.

It is divided like this:

*** sky  scraper ***

You have a total of 9 out of
ten right on level 4, grade 3
using compound words.

Would you like to play with
one of my special rewards,
Fred (Y = YES N = NO)? Y__

# APPENDIX B
# DICTIONARY HUNT SAMPLE SCREENS

What level would you like to work on (1, 2, 3, 4, or 5)? 2

What is your password for level 2 (type it and press ENTER) yogurt_____

```
LEVEL 2      # 1      0  RIGHT

  The word is "avocado".

  1. Would you eat it?
  2. Would you wear it?
  3. Would you live in it?

  Would you really wear it? _

  Look "avocado" up in
  the dictionary Fred!
```

```
LEVEL 2      # 1      0  RIGHT

  The word is "avocado".

  1. Would you eat it?
  2. Would you wear it?
  3. Would you live in it?

  I'll wait for you. _
```

```
LEVEL 2      # 1      0  RIGHT

  The word is "avocado".

  1. Would you eat it?
  2. Would you wear it?
  3. Would you live in it?

  You got it Fred! _

  An avocado is something
  to eat!
```

LEVEL 2 word list for Fred:

| | |
|---|---|
| avocado* | quiche |
| castle-PW | moccasin |
| taco | fondue |
| chalet | wigwam |
| beret | kilt |
| mansion | turban |

(* Word missed on first try.)
(PW Your password for level 3.)

Press ENTER to continue.

I hope you have enjoyed today's hunt, Fred.

You got ALL the questions right on level 2!

Your password for level 3 is: "castle". Copy it down!

Press ENTER to continue.

APPENDIX C

Name _____

Grade _____

School _____

Compound Words

Directions: Draw a line to separate the words that form each compound word.

| | |
|---|---|
| b e d r o o m | h i g h w a y |
| h i l l t o p | s u n l i g h t |
| d a y t i m e | h a i r b r u s h |
| b i r d h o u s e | f o o t p a t h |
| e y e l i d | q u a r t e r b a c k |
| a r m h o l e s | c l u b h o u s e |
| w e e k e n d | g o l d f i s h |
| w h i t e c a p s | b l a c k b e r r y |
| l u n c h r o o m | d i s h w a s h e r |
| t e a s p o o n | t u g b o a t |
| h a n d s h a k e | f o o t b a l l |
| w a g o n w h e e l | t a b l e t o p |

Prefixed Words

Directions: Draw a line to separate each prefix and root word.

| | |
|---|---|
| undo | inexcusable |
| disconnect | transform |
| preheat | misbehave |
| demerit | interchange |
| interstate | interrelate |
| interknit | misinform |
| reopen | insane |
| repaint | misjudge |
| undress | display |
| explain | deplane |
| inflame | distaste |
| depress | extend |

Suffixed Words

Directions: Draw a line to separate each root word and the suffix.

| | |
|---|---|
| cupful | neatly |
| thankful | useless |
| speaker | harmless |
| wisely | foolish |
| goodness | roomy |
| sinkable | softest |
| windy | gentleness |
| straightest | harden |
| dangerous | statehood |
| golden | brighten |
| casement | courageous |
| homeless | returnable |

APPENDIX D

Name _____

Grade _____
School _____

Compound Words

Directions: Draw a line to separate the words that form each compound word.

| | |
|---|---|
| b a t h r o o m | h i m s e l f |
| a i r p l a n e | s u n f l o w e r |
| c l a s s r o o m | s t e p m o t h e r |
| e a r a c h e | b a s k e t b a l l |
| b u t t e r f l y | h u m m i n g b i r d |
| p o c k e t b o o k | s i d e w a l k |
| f i n g e r p a i n t | h o m e w o r k |
| b o o k m a r k | r i n g l e a d e r |
| b a c k y a r d | f i n g e r n a i l |
| l i g h t h o u s e | r o w b o a t |
| g r a n d m o t h e r | b a s e b a l l |
| p a n c a k e | d a y t i m e |

Prefixed Words

Directions: Draw a line to separate each prefix and root word.

| | |
|---|---|
| redo | dethrone |
| untie | misspell |
| dishonest | misfile |
| defrost | intermission |
| insufficient | misinterpret |
| superheat | interconnect |
| misquote | disorder |
| retell | prepay |
| retie | distrust |
| disagree | rewrite |
| prefix | transmigrate |
| inseam | expound |

Suffixed Words

Directions: Draw a line to separate each root word and the suffix.

| | |
|---|---|
| playful | teacher |
| sweetly | restful |
| hopeless | spoonful |
| painless | restless |
| boyish | messy |
| lucky | darkness |
| sheepish | firmer |
| freedom | personal |
| basement | enjoyment |
| attractive | comical |
| straighten | heighten |
| childish | amazement |

APPENDIX E

Name _____

Grade _____

School _____

In each of the following three sections, match a definition from Column I with a noun from Column II by placing the letter of the correct answer in the space provided in Column I. In the space provided in Column III, indicate whether the object in Column II would be EATEN, WORN or LIVED IN by using the letters E, W, or L.

| Col. I | | Col. II | Col. III E/W/L |
|---|---|---|---|
| G | 1. Italian pie with cheese and sauce | A. loafer | |
| | 2. deer meat | B. tuxedo | |
| | 3. residence of a king | C. tepee | |
| | 4. man's semiformal jacket | D. venison | |
| | 5. lodging for soldiers | E. palace | |
| | 6. casual shoe | F. barracks | |
| | 7. American Indian tent | G. pizza | E |
| | 1. armed residence of a nobleman | A. moccasin | |
| | 2. heelless soft leather shoe | B. wigwam | |
| | 3. melted cheese dish served with bread | C. kilt | |
| | 4. male Muslim's headdress | D. castle | |
| | 5. American Indian hut | E. turban | |
| | 6. skirt worn by men in Scotland | F. fondue | |
| | 1. outer garment of Hindu women | A. frock | |
| | 2. dancer's skintight garment | B. kasha | |
| | 3. blanketlike shawl worn in Latin America | C. sari | |
| | 4. house with individually owned apartment | D. serape | |
| | 5. cooked grain, especially buckwheat | E. condominium | |
| | 6. coarse outer garment of monks | F. leotard | |
| | 1. cereal grain | A. bungalow | |
| | 2. loose-fitting short trousers | B. wickiup | |
| | 3. small house at the seashore | C. adobe | |
| | 4. folded thin pancake with filling | D. blintze | |
| | 5. American Indian hut | E. knickers | |
| | 6. building made of sun-dried clay bricks | F. millet | |
| | 1. loaf of braided bread | A. hermitage | |
| | 2. portable dwelling of nomads | B. hogan | |
| | 3. Middle Eastern pastry | C. chitterlings | |
| | 4. secluded residence | D. baklava | |
| | 5. fried small intestines of pigs | E. yurt | |
| | 6. Navaho Indian dwelling | F. challah | |

APPENDIX F

Name _____

Grade _____

School _____

In each of the following three sections, match a definition from Column I with a noun from Column II by placing the letter of the correct answer in the space provided in Column I. In the space provided in Column III, indicate whether the object in Column II would be EATEN, WORN or LIVED IN by using the letters E, W, or L.

| Col. I | | Col. II | Col. III E/W/L |
|---|---|---|---|
| G | 1. Italian pie with cheese and sauce | A. sash | |
| | 2. head covering tied under the chin | B. lasagne | |
| | 3. Italian pasta dish | C. crouton | |
| | 4. Eskimo dwelling built of snow | D. yogurt | |
| | 5. custardlike cultured milk product | E. igloo | |
| | 6. band worn around the waist | F. bonnet | |
| | 7. toasted bread cubes | G. pizza | E |
| | 1. green tropical fruit | A. taco | |
| | 2. soft brimless cap | B. quiche | |
| | 3. egg pie | C. mansion | |
| | 4. large, impressive residence | D. chalet | |
| | 5. flat Mexican cornbread with filling | E. beret | |
| | 6. Swiss style ski lodge | F. avocado | |
| | 1. Japanese dish | A. borscht | |
| | 2. beet soup with sour cream | B. hacienda | |
| | 3. main house of a Mexican ranch | C. chateau | |
| | 4. bean curd | D. shanty | |
| | 5. French castle | E. sukiyaki | |
| | 6. small, flimsy house | F. tofu | |
| | 1. wreath of flowers | A. papaya | |
| | 2. leather leggings worn by cowboys | B. villa | |
| | 3. large rich country residence | C. fedora | |
| | 4. flavored sauce made of mashed avocado | D. chaps | |
| | 5. soft felt hat with curled brim | E. guacomole | |
| | 6. yellow, tropical, melonlike fruit | F. lei | |
| | 1. rice cooked in broth | A. sarong | |
| | 2. supervised lodging for young people | B. camisole | |
| | 3. woman's short undergarment | C. hostel | |
| | 4. skirt worn by Pacific Islanders | D. weskit | |
| | 5. vest | E. brogan | |
| | 6. coarse, ankle-high work shoe | F. pilaf | |

REFERENCES

Bernstein, S. (1983, August). Crisis in education: Can the computer help? Softside, pp. 23-24.

Clement, F. J. (1981, April). Affective considerations in computer-based education. Educational Technology, pp. 28-32.

Coburn, P., Kelman, P., Roberts, N., Snyder, T., Watt, D., & Weiner, C. (1982). Practical guide to computers in education. Massachusetts: Addison-Wesley.

Doerr, C. (1979). Microcomputers and the 3 r's: A guide for teachers. Rochelle Park, NJ: Hayden Book Company.

Downing, B. (1982, May/June). Educators should be taking the lead. Electronic Learning, p. 19.

Dyer, C. (1972). Preparing for computer assisted instruction. New Jersey: Educational Technology Publications.

Frenzel, L. (1984a, June). Authoring CAI. Computer User, pp. 29-30.

Frenzel, L. (1984b, July/August). Personal computers in schools. Computer User, pp. 17-18.

Gattis, W. (1982, May/June). High quality software a rare find. Electronic Learning, p. 19.

Golden, F. (1982, May). Here come the microkids. Time, pp. 50-56.

Levin, D. (1982, March). In this system, the computer future is now. The American School Board Journal, pp. 27-28.

Kahl, E. (1982). The use of microcomputers in English education. Unpublished master's thesis, State University of New York at Oswego.

Kahl, E., & Podolski, F. (1983, June). Don't buy a forty chicken alligator or the evaluation of educational microcomputer software. Paper presented at the 9th Annual Louisiana Migrant Conference, New Orleans, LA.

Kimberly, P. (1981). Microprocessors: An introduction. New York: McGraw-Hill Book Company.

Ramer, B. (1981, February). Statement before the New York State Education Committee for Instructional Technology. Albany, NY.

Sheingold, K. (1981, February). Issues related to the implementation of computer technology in schools: A cross-sectional study. Preliminary report presented to the National Institute of Education Conference. Washington, D. C.

Staff. (1982, June). Practical suggestions. Practical Applications of Research: Newsletter of Phi Delta Kappa's Center on Evaluation, Delvelopment, and Research, p. 3.

Steinberg, E. R. (1984). Teaching computers to teach. New Jersey: Lawrence Erlbaum Associates.

Taffee, S. J. (Ed.). (1985). Computer in education 85/86. Connecticut: Dushkin.

Topp, R.H. (1985, February). State of the art: Microcomputers in elementary education 1984. The Computing Teacher, pp. 43-47.

U.S. approaching more than one million computers in schools. (1984, November). The Computing Teacher, p. 9.

Zientara, P. (1984, February 6). B.F. Skinner: Computers can cure what's wrong in American education. InfoWorld, pp. 23-25.